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GULF BIOLOGIC STATION

CAMERON, I.A.

BULLETIN No. 11

Preliminary Report on the Life History and
Habits of the "Lake Shrimp"

(*Penaeus Setiferus*)

BY

M. H. SPAULDING

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THE DAILY STATE, OFFICIAL JOURNAL OF LOUISIANA,
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ISSUED BY THE

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GULF BIOLOGIC STATION

CAMERON, LA.

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PRELIMINARY REPORT
ON THE
Life History and Habits of the
"Lake Shrimp."
(*Penaeus Setiferus*.)

BY M. HERRICK SPAULDING.

INTRODUCTORY.

At the last session of the Legislature there was some little agitation in favor of a law placing a closed season on the large "Lake Shrimp" (*Penaeus setiferus*), which is so abundant along the gulf coast. The lack of sufficient data covering the points at issue caused the matter to be dropped for the time being.

The present investigation was undertaken to provide this desired and much-needed information, in so far as it was possible to do so with the time and facilities at our disposal. In addition to the section dealing especially with the form in question, some notes on the other species of shrimp found in these waters are given in the second part of the present report.

THE POSITION AND IMPORTANCE OF THE SHRIMP FISHERY.

Although the shrimp industry is to be considered as still in its infancy, it has grown rapidly in size and importance in the last few years, and now is second only to the oyster industry.

The status of the industry can best be shown by quoting from the statistics of the United States Fish Commission. Although

these figures refer only to the period from 1889 to 1902, they will serve to show the development which has taken place during that time.

For the sake of comparison some little reference must be made to the oyster industry, and this can best be done by quoting from the Report of the Bureau of Fisheries for 1902:

"The oyster industry, the most important branch of the fisheries of this State, as well as of the United States, shows a larger yield than in 1897, increasing from 959,190 bushels, worth \$432,668, to 1,198,413 bushels, worth \$433,227. In 1890 it was only 44,800 bushels, worth \$127,990. The growth of this industry is due to an increased demand rather than to a greater abundance on the reefs. The cultivation of oysters is attracting much attention in Louisiana, and well-directed efforts are now being made to develop profitable use of grounds at present unproductive."

"The seine fishery shows a very large increase since 1897, especially in the product, increasing from 6,554,749 pounds, worth \$173,454, to 12,565,415 pounds, worth \$251,826. The yield of shrimp contributed the bulk of this, the catch being 7,589,220 pounds, worth \$130,560, whereas in 1897 it was only 4,402,626 pounds, worth \$78,792."*

The above quotation gives a fair idea of the status of the industry in 1902. The following tables give a more detailed statement of the growth in different years, and also the relative importance of the fishery to the different coastal parishes of the State.

TABLE I.

SHOWING THE GROWTH OF THE INDUSTRY FROM 1889 TO 1902.

	1889 (a)	1890 (a)	1897 (b)	1902 (b)
Pounds	7,121,500	6,540,150	4,402,626	7,589,220
Value	\$93,640	\$88,115	\$78,792	\$130,560

This species is confined to the salt or brackish bayous of the coast, and seldom, if ever, is caught in any abundance elsewhere. The following table gives a summary of the catches made in the

*Report of Bureau of Fisheries, 1902, Page 465.

(a) Bulletin, United States Fish Commission, 1890, pp. 91-184.

(b) Report, United States Bureau of Fisheries, 1902, p. 465.

different coast parishes, showing the relative importance of the industry to the different parishes:

TABLE II (c).

SHOWING THE CATCH OF SHRIMP AND VALUATION OF SAME IN THE DIFFERENT COAST PARISHES.

	Pounds.	Value.
Cameron	900	\$ 54
Jefferson	6,551,470	107,965
Lafourche	885,700	19,410
St. Bernard	17,000	380
St. Mary	72,850
Terrebonne	61,300

HABITS.

Shrimp are shy, active animals, which are constantly moving about from place to place, frequently being found in large "schools." This species (Lake Shrimp) is found only near the coast, and seldom, if ever, enters fresh water. On account of their extreme timidity it is very difficult to make observations on their habits—or even to keep track of their movements. In spite of their great abundance in certain sections of the coast of the United States, but little has been done in this country towards increasing our knowledge of their habits and life history. In fact, but one study has been made of a part of their development (d), although there was some question as to the species studied (e). It is hoped that this investigation may be continued until their life history is more completely known.

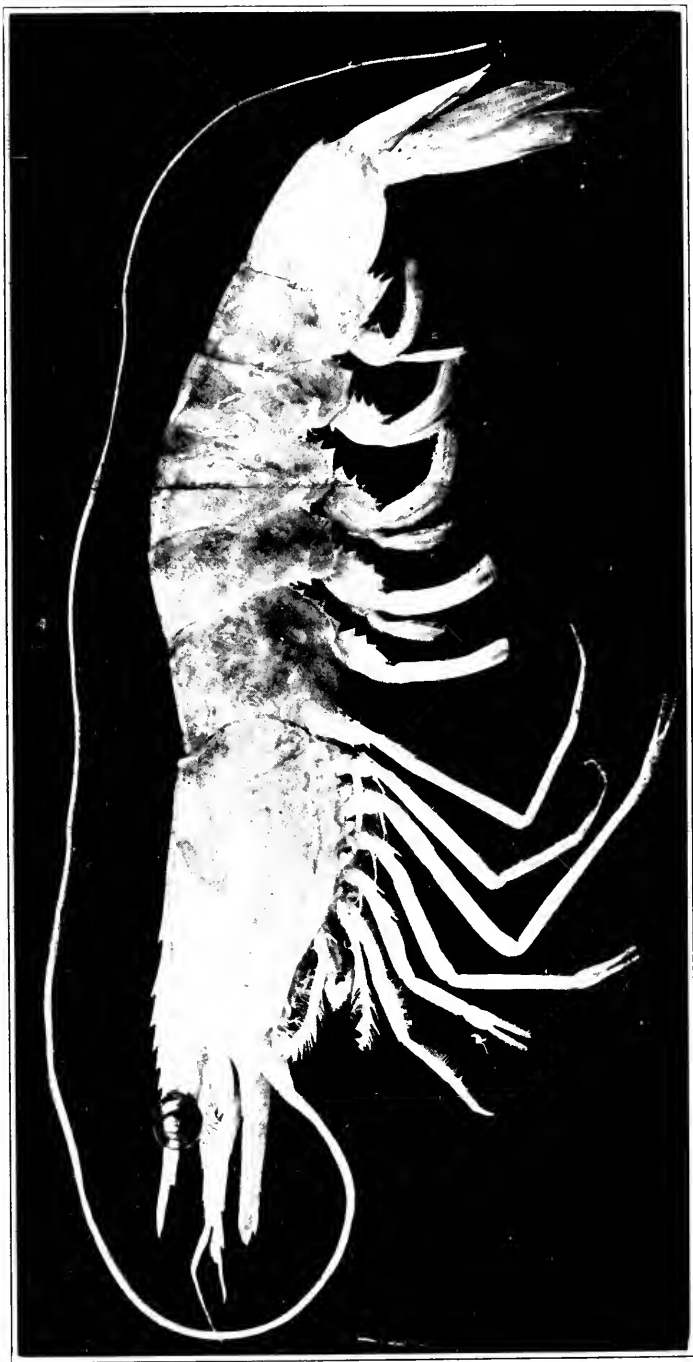
ANATOMICAL.

Although this form is very well known to the fishermen along the coast and in the markets, it is necessarily more unfamiliar to those residing in the interior parishes of the State. For that reason, as well as to render the more technical references understandable, a brief description of some of the main anatomical features will be necessary.

(c) Report, 1902, pp. 468-469, 470-473.

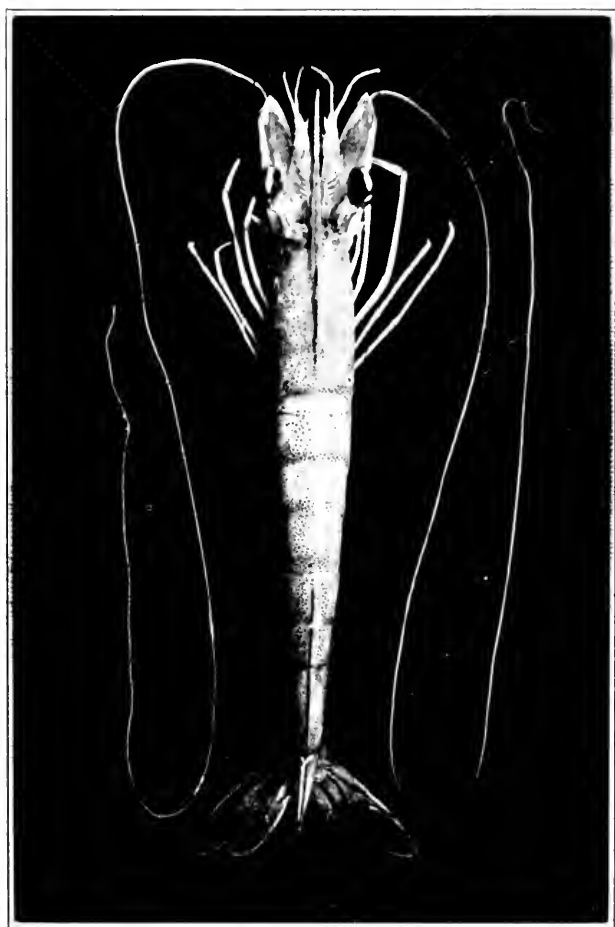
(d) Brooks, W. K., The Development of *Penaeus*, Johns Hopkins University, Circ., Vol. II, 1882.

(e) The species in question was thought to be *Penaeus braziliensis*.



M. H. S., Photo.

PLATE I.—“Lake Shrimp” (*Penaeus setiferus*).



M. H. S., Photo.

PLATE II. "Lake Shrimp" (*Penaeus schifocosa*).

The body, as is shown in the accompanying figure (Pl. II), is very much compressed, giving the body an extremely slender appearance. It is covered with a firm, tough outer skin, or shell, which corresponds to that of the common market crab, although it never becomes as hard and firm as it does in the latter form.

The body is composed of two main regions (as is shown clearly in *Plates I and II*), the anterior head region and the posterior

tail region or abdomen. The latter is composed of several similar rings or segments. In the body part this ring-like structure (or segmentation) is more or less obscured by the large shield-like *carapace*, which covers the back and sides, and is continued anteriorly as a long, serrated spine, the *rostrum*.

When first caught the shrimp is extremely beautiful in the delicacy and vividness of its coloration. The body is more or less translucent, and has a delicate reddish tint, caused by numerous small reddish spots. The tips of the walking legs, the long antennae, and the swimmerets are usually extremely brilliant in their tinting. The tips of the tail-fin are usually a deep phosphorescent blue, shading into dark brown or black towards the base of the appendage, while the heavy fringe of long hairs surrounding the blades is usually a bright red. Different individuals show a marked variation in the general coloration; some being especially vivid, while others will be nearly colorless. In general, the brilliancy seems to be affected by the recentness of the last moult, those which have just shed their skin being more brightly colored than those which are on the verge of moulting.

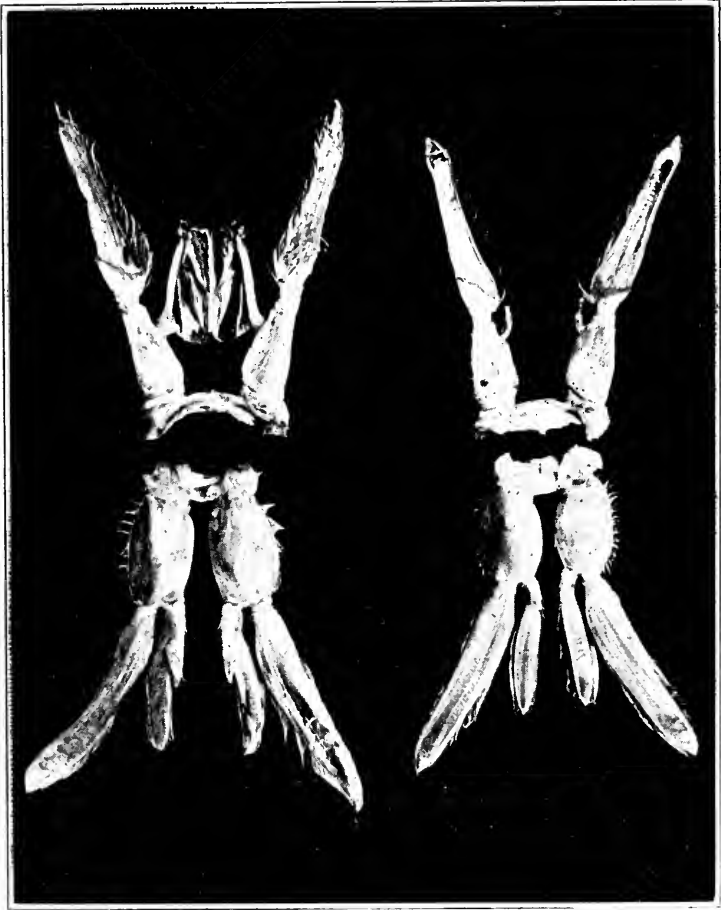
Each segment, or ring, of the body bears a pair of appendages which are variously modified to serve different functions. In the anterior part of the body they serve as feelers, mouth parts, and walking legs. Those on the abdomen serve as paddles in swimming, and on that account are called "swimmerets." Although the different appendages are superficially very different from each other in general shape, this is the result of modifications to fit them for the special use, and all are built on the same general plan. Some of the appendages are large and conspicuous, while others are very small and require a careful examination in order to make them out. It will not be necessary for our purposes to give a detailed account of the various changes which have brought about the modifications in the different appendages, and reference will only be made to those appendages which are of special use in reproduction.

Attention must be called to one of the modifications of the walking legs which is much used in separating this group of shrimp from the others. The large figure (*Plate I*) of this species shows that three of the walking legs have pincer-like tips,

which are used in capturing prey or in seizing foreign bodies in the water. These pincer-like structures are called *chelae*, and the whole appendage is said to be *chelate*. In the division to which the "lake shrimp" belongs all have three pairs of chelate legs, but the members of the other divisions of shrimps have but two pairs of chelate legs. Although this is an external character, it is on that account very useful, and there are other modifications in structure accompanying these differences, so that it is very useful in separating the shrimp into the groups to which they belong.

In the lower side of the abdomen are six pairs of appendages. All of these, except the last pair, are similar in general shape as well as in structure. Each appendage consists of a basal, two-jointed stalk, at the outer end of which are two narrow, blade-like processes. (*Plate III.*) As already mentioned, the chief function of these appendages is swimming paddles, serving to propel the animal slowly forwards. In the females of many of the shrimps they serve also as egg-carrying organs, and the eggs are attached to them by a gelatinous secretion and are carried about by the female until they hatch. The female of the "River Shrimp" (*Bithynis ohionis*), is an excellent example of this, and many will be found in this condition throughout the entire summer. The figure of this species given at the end of this report shows this habit. (*Plate V. figure 1.*) The last pair of abdominal appendages are different in shape from the others and are apt to be overlooked as appendages. Instead of being inserted at an angle with the abdomen they lie nearly parallel to it, forming, with the tip of the abdomen, the so-called "tail-fin." This structure is used as a powerful paddle in executing rapid backwards movements when attempting to escape from a predaceous form. The whole abdomen enters into the movement, which causes the shrimp to move backwards in a jerky manner.

In the present report the modifications of the first two pairs of swimmerets of the males are of special interest. In the females but slight modifications of these appendages are found: the greatest being that the inner filaments of the first pair are very much smaller than those of the following appendages and are apt to be overlooked. In the males, however, the changes are very pronounced. In the first pair of swimmerets in this sex the inner filaments are modified into delicate, slightly wrinkled



M. H. S., Photo.

PLATE 111.—First and second pairs of swimmerets, of the male and female, showing the changes which have taken place in the male. (Those of the male on the left, the female on the right.)

membranes, which are fused along the median line uniting the pair of appendages. In the natural position this membrane forms a crude tube with a slightly enlarged apex. The second pair are less modified, the only change being a short spine developed on the inner side of the inner filament. During copulation the tube of the first pair functions in the transference of the sperm, while the second pair aid as supporting organs in some

manner. These modifications are shown in the accompanying figure (*Plate III*).

While the differences just noted offer the best means of separating the sexes, at certain seasons of the year another difference is present which is made use of by the fishermen. During the breeding season, and for a short time preceding it, the basal segments of the last pair of walking legs takes on a conspicuously whitish appearance, due to the enlargement of the terminal portion of the sperm duct. To the fishermen this offers the best means of separating the males from the females, but of course is of value for only a part of the year, while the structure of the swimmerets is available for all except the very young. There are also slight modifications of the filaments of the antennae in the males, but as they are inconspicuous it will not be necessary to describe them in detail.

REPRODUCTIVE ORGANS.

The internal reproductive organs consist of the glands which develop the sex products and the ducts which carry these products to the exterior. These glands occupy corresponding positions in the body sexes and are in general alike in the two sexes.

FEMALE REPRODUCTIVE ORGANS.

The egg-gland, or *ovary*, of the female lies in the dorsal part of the body cavity a short distance in front of the posterior end of the carapace. It consists of a central, ring-like portion (composed of partly-fused halves), from which finger-like processes are sent off on all sides. The anterior and lateral processes are short and rather small, but the posterior pair are long and slender, extending the entire length of the abdomen. In this gland the eggs are formed and matured and are then discharged from the body through a pair of slender *oviducts*, which open through the basal segments of the last pair of *chelate* legs.

MALE REPRODUCTIVE ORGANS.

The gland of the male, the *testis*, occupies a similar position. It is, however, a more compact structure and the processes are much shorter than in the ovary, and do not extend far from the central mass. The posterior processes are noticeably much shorter than those of the ovary. The sperm ducts are a pair of

thick, slightly coiled tubes leading from the lower side of the central mass to the external openings in the basal segments of the last pair of legs. The terminal portion of the duct is much enlarged and nearly fills the basal segment. As already mentioned, it becomes very conspicuous at the breeding season. During the breeding season the sperm ducts are swollen and filled with the *milt*, a thick viscous fluid, the greater part of which is made up of sperm. The *sperms*, the vital part of the milt, are small, roundish bodies, with a short process on one side. At the time of mating the sperm are formed into masses called *spermatophores* and are attached to the ventral surface of the female (in a crude pouch or pocket between the bases of the legs) by the tubular part of the first pair of swimmerets. It is probable that the enlarged terminal portion of the sperm ducts enter into this transference in some manner; but, as the mating has not been observed in this form, the exact way in which this takes place is not known.

The fertilization of the eggs (i. e., the fusion of the sperm and the egg) takes place as the eggs are extruded from the oviducts, usually some time after mating.

EGG LAYING HABITS.

In the majority of the shrimp the female carries the eggs during their development attached to the under side of the abdomen, between the swimmerets. Females in this condition, or in "berry," as it is sometimes called, are shown in Plate V, figures 1-2. The group of shrimp to which the "Lake Shrimp" belongs (*Penaeidae*), however, differs from the others in this respect, and it is claimed that the eggs are not attached to the swimmerets of the female during development. (a) The eggs are merely set free into the water and allowed to shift for themselves during development. This means that they are at the mercy of the currents in the water or may fall easy prey to any of the predaceous forms living in these regions. On this account many more eggs are produced by each female than would be in those forms which protect the eggs by carrying them during the early development. The eggs are also rather small and undergo their early development floating around at the surface of the water. In this con-

(a) Rathbun, Bull., 4 S. F. C. 1900, Vol. 2, page 100.

nection the belief of the fishermen concerning the breeding of the shrimp is perhaps of interest.

The fishermen claim, so I have been told, that the large shrimp come into the shallow parts of the large bays along the coast in the fall and deposit their eggs in the soft, muddy bottoms. Here the eggs pass the winter and slowly develop. In the spring the young shrimp force their way out of the mud, causing the water to become very muddy. While it may be true that many small shrimp are found in these places at that time of the year, they are probably other species, and would in no way have much of any influence on the condition of the water. This will perhaps be more apparent when it is mentioned that the developing shrimp passes through the several stages in its life history while floating at the surface of the water.

On the South Atlantic Coast it is claimed that this shrimp (*or a closely related species*) breeds in the deeper water. (b.) A similar habit may be found in this region, which would account for the absence of the larger specimens from the fishing grounds during the summer months.

LIFE HISTORY.

The period of growth in the egg is very short in this form and the young hatches out in a very immature condition. Although this stage has not yet been taken in this region, it is not likely that it will prove to be different from those already studied. At this time the larval shrimp has an oval body, but three pairs of appendages, and a single, median eye—and is now called a *nauplius*. The majority of shrimp pass through this stage while still in the egg. The young shrimp is now capable of making feeble movements and can in a measure direct its course.

As already mentioned, the shrimp is covered with a hard, firm covering, the *exoskeleton*. As this is a tough, unyielding layer it is necessary to get rid of it from time to time in order that growth may take place. This is done by the shedding of this coat, which is known as *moulting*, at which time the outer covering of the body is sloughed off as a thin layer, retaining the external shape of the body. On this account we find that growth takes place by a series of steps or jumps and not in a regular,

(b) Brooks, The Development of *Penaeus*, Johns Hopkins Univ. Circ., Vol. II, 1882.

imperceptible manner—as is the case with so many animals. The actual enlargement of the body of the shrimp takes place almost immediately after the shedding of the skin, so that a short time after the moult one would hardly believe that the shrimp could have but recently occupied the cast skin.

Before assuming the adult form of body the young shrimp passes through several changes of shape. In each stage there are several moults and a gradual increase in the number of appendages takes place. Unfortunately, we have not yet been able to secure the younger stages in the life history of this species, but it is hoped that it will be possible to complete the series.

During the latter part of August and during September larval shrimp (less than a half an inch in length) were fairly common in Calcasieu Pass, being caught with a fine-meshed tow-net. The youngest of these had already assumed the adult form of body, except in a few of the minor details. These immature forms were all perfectly transparent, with the exception of the jet-black eyes. In these stages the growth is rather rapid, but as a complete series was not obtained it is impossible at present to estimate the time consumed in the transformation.

OBSERVATIONS ON ADULTS.

Although it has been impossible to secure as complete a series of the adults as was desired, still some points of interest have developed from the investigation. It might be noted that in Calcasieu Pass the movements of the shrimp are very erratic; being in large measure dependent upon the conditions of the water and weather. The former is extremely variable in salinity, dependent on the amount of rainfall, direction of the prevailing winds, etc. On this account it often happens that for relatively long intervals no shrimp will be caught. Then may follow an interval when a few can be caught each day—followed by another period when they are apparently absent from the Pass.

On account of their extreme delicacy it has been impossible to keep them under artificial conditions, where they may be watched, for any length of time. In this respect they are notably different from the "River Shrimp" (*Bithynis ohionis*), which is much easier to keep alive in a relatively small aquarium. With better facilities for keeping the shrimp alive undoubtedly

much more could be learned concerning the habits which are at present unknown.

The first shrimp were caught this year in the latter part of March. All were small and sexually undeveloped. No large individuals were caught until much later in the season. At this time the gonads (reproductive organs) were very small and inconspicuous, in fact being rather hard to find. But little change in the size of the individuals or in the condition of the gonads was found until the latter part of April. At this time the catch had shown a gradual increase in size, although small individuals were still rather common. At this time the males began to show signs of approaching maturity, as evidenced by the increase in the size of the testes and by the terminal portion of the sperm duct (in the basal segment of the last pair of legs) becoming conspicuously white. During the following month the relative number of matured males continued to increase until by the latter part of May practically all the males caught were with mature glands. None of these, however, were above medium size and large-sized individuals were not caught until rather late in the summer.

Although many females were caught at the same time, the increase in the size of the ovary was not as conspicuous and in none of the specimens caught were there any which indicated that the ovary had attained full size.

In the latter part of May the shrimp were driven from the Pass by the heavy spring freshet. The heavy freshets this past spring were extremely troublesome and caused a great deal of damage.

As other duties required my absence from the Station for the next two months, no observations were made until the latter part of July. At this time shrimp were again fairly common in the Pass, but none of them showed any signs of sexual maturity. In fact, in every case examined, all seemed to have returned to the same stage of development as that found in the specimens caught in the early spring. During the latter part of August and during September the shrimp were exceedingly numerous at times and records were kept with a fair amount of regularity. During this period they were growing rapidly and the majority of specimens captured had either recently moulted or were about

to do so. At this time some of the largest individuals caught in the Pass this season were secured, although none were as large as some which were dredged in the gulf near the Pass last November (November 24, 1906). In none of these larger specimens was there any signs of an increase in the size of the gonads. In the accompanying table is given a record of the sizes taken on different dates. While this represents the examination of a rather small series, still in a measure it indicates the size of the individuals at the different seasons of the year. Probably the most significant feature about this series is that young individuals (i. e., less than three inches in length) were found at practically all seasons of the year, in so far as the record has been kept.

TABLE III.

Showing comparative sizes caught at different dates during the year. (The measurements indicate the length from the base of the eye-stalk to the tip of the tail.)

Length—Inches	March 29	April 20-27	May 10-20	Sept. 14-30	Oct. 15-22	Nov. 15-30
13-16	..					
15-16	..					
1 1-16	..					
1 1-8
1 3-16						..
1 1-4		
1 5-16						..
1 3-8
1 7-16
1 1-2	
1 9-16			
1 5-8
1 11-16				
1 13-16				..		
1 7-8		
1 15-16				..		
2		
2 1-16
2 1-8				..		
2 3-16			
2 1-4				
2 5-16				..		
2 3-8					..	
2 7-16				..		
2 1-2				
2 9-16					..	
2 5-8				
2 11-16				..		
2 3-4		
2 13-16				
2 7-8		
2 15-16				
3				..		
3 1-16	
3 1-8				
3 1-4				
3 3-8					..	
3 7-16	
3 1-2					..	
3 9-16		..				
3 5-8					..	
3 11-16		
3 3-4					..	
3 13-16		..				
3 7-8					..	
4					..	
4 1-16					..	
4 1-8			..			
4 3-16		

TABLE III.—Continued.

Showing comparative sizes caught at different times during the year. (The measurements indicate the length from the base of the eye-stalk to the tip of the tail.)

Length—Inches	March 29	April 20-27	May 10-20	Sept. 14-30	Oct. 15-22	Nov. 15-30
4 1-4.....					"	
4 5-16.....		"	"	"		
4 3-8.....		"			"	
4 7-16.....		"		"	"	"
4 1-2.....					"	"
4 9-16.....		"				
4 5-8.....		"		"		
4 3-4.....		"			"	"
4 13-16.....					"	
4 7-8.....					"	
4 15-16.....				"		
5.....					"	
5 1-16.....						"
5 1-8.....				"	"	"
5 3-16.....				"		"
5 7-16.....						"
5 1-2.....						"
5 9-16.....						"
5 5-8.....						"

SUMMARY AND CONCLUSIONS.

In spite of the incompleteness of the present report, it is thought that some points of interest have been found out, and it is hoped that it will form a basis for additional investigation.

1. There is a breeding season during the summer months, beginning about the middle of June; this is indicated by the sexual maturity of the males a short time before then and by the abundance of larval stages during the months of August and September.

2. The eggs are not carried about by the females of this species, but are allowed to shift for themselves.

3. It is possible that the mating and laying of the eggs takes place in the deeper water of the larger bays or even in the Gulf.

4. Growth takes place rapidly in the fall, when the largest specimens are caught. As yet none have been caught which indicated a fall or early winter breeding period.

5. PROBABLY THE MOST INTERESTING FACT BROUGHT OUT IS THE FINDING OF BOTH LARGE AND SMALL SPECIMENS AT ALL SEA-

SONS OF THE YEAR. This may indicate either a very long breeding period during the summer months or two breeding seasons during the year. The present study did not extend through the entire year and so we have no information concerning the status of the shrimp during the winter months. It is hoped that the investigation may be continued until this and other points may be elucidated.

Several points were not determined, and it is hoped that these will be taken up in some future study; of these, the QUESTIONS OF THE RATE OF GROWTH AND LENGTH OF LIFE OF THE INDIVIDUAL ARE OF IMPORTANCE.

At present, without more complete information concerning the life history of this form it would hardly seem advisable to adopt regulations for its protection. Most of the agitation for such protection has been based on the plea that as young individuals were caught during the summer months fishing at that time should be prohibited. Without more detailed information concerning the place and actual times of breeding intelligent steps can not be taken. If it is found that the shrimp lay their eggs in the deeper water, they are not in much danger of being overfished at that time, provided that the supply is not lowered by fishing below the point where they are able to keep the supply constant by normal reproduction. This point seems to be a vital one in all animals of commercial importance to man. By the constant inroads upon the natural supply the number of breeding individuals is gradually lowered until there comes a time when the supply begins to decrease. When that point is reached active steps are usually demanded to protect the commercial interests. In some cases it has been necessary to entirely prohibit the catching of certain forms for a period of years in order to permit them to recuperate by natural means; yet at best this is but a temporary advantage and some more efficient safeguard is needed. In the case of the oyster industry this need was met by the bedding method; some of the fishing industries are possible today by the artificial rearing of the young fish. At present our knowledge of the habits of the shrimp are too incomplete to prophesy just what method would be most beneficial in meeting the demands made upon them, and it is hoped that no restrictions will be adopted until this information is supplied.

If, however, it seems imperative that steps be taken at once, it will probably be more beneficial to restrict the fishing to all shrimp above a minimum size. This could very easily be done by limiting the size of the meshes of the seines used (i. e., the mesh should be large enough so that the shrimp below lawful size could easily pass through). Although it has been suggested that the smaller specimens might be injured in passing through the seine, it is not likely that a perceptible number would be seriously affected. From the standpoint of the canners this would be extremely beneficial, as the smaller shrimp can not be economically handled. At the same time it should be noted that there is a possibility that some of the smaller species of shrimp may be confused with the young of this species. It is also recommended that the investigation be made, if possible, in the parishes where the shrimp are more abundant than they are in Calcasieu Pass.

Cameron, La., December 20, 1907.

PART II.

NOTES ON SHRIMP FOUND ON THE COAST OF
LOUISIANA.

In our collecting along the coast a number of shrimp have come to our attention, some of which are of interest.

PENAEIDAE.

(Forms with three pairs of chelate legs.)

1. *Panacus setiferus* (Say). "Lake Shrimp." (Plate I, II.)
The "Lake Shrimp" is the largest and most important species, commercially, of any found in these waters.
2. *Penaeus braziliensis* (Latrielle).
This species is very similar to the preceding one, from which it is separated by minor structural differences. It is reported as being found in these waters, but none have been taken by the writer.
3. *Parapenaeus constrictus* (Stimpson). (Plate IV, figure I.)
This is a smaller species of this same group, which was dredged in the gulf near Calcasieu Pass in the fall of 1906. While probably common along the coast is never very abundant.
4. *Xiphopenaeus kroyeri* (Heller). (Plate IV, figure 2.)
A rather delicately colored species, which is easily distinguished from the preceding by its long, slender rostrum and by the extreme length of the last two pair of walking legs. Has been taken in the dredge in the gulf near Calcasieu Pass and also a few times in the lower part of the Pass. One or two of the specimens obtained were about twice as large as the one figured.
5. *Sicyonia dorsalis* (Kingsley). (Plate IV, figure 3.)
A delicately colored and sculptured form, a few specimens of which were dredged in the gulf near Calcasieu Pass November (1906).

CARIDAE.

(Forms with but two pairs of chelate legs, mostly smaller species.)

6. *Bithynis ohionis* (Smith). (Plate V, figure 1.)

The so-called "River Shrimp." Very abundant in the Mississippi River and has also been taken a few times in the Calcasieu River. Smaller than the large "Lake Shrimp," but highly prized as a table form. This species is entirely a fresh-water form, and may become about twice as large as the specimen figured. The breeding season is very long and females in "berry" may be found from April through into the summer. The exact length of the breeding season has not been determined.

7. *Palaemon tenuicornis* (Say). (Plate V, figure 2.)

A smaller species, with a rather compact body, found in the salt or brackish water along the coast.

8. *Palaemonetes carolinus* (Stimpson). (Plate V, figure 3.)

This small species is sometimes called the "Grass Shrimp," from its habit of lurking among the weeds and grasses bordering the bayous and smaller streams along the coast. It is a salt or brackish water form, but seldom becomes as large as the preceding species. At times it has been extremely abundant in Calcasieu Pass, especially during summer. Females in "berry" are found throughout the latter part of the summer.

9. *Tozeuma carolinense* (Kingsley).

A rather peculiarly shaped form, with a very long rostrum, a single specimen of which was found among the sea weeds near Errol Island in the spring of 1906.

10. *Thor floridanus* (Kingsley).

A small species, a few specimens of which were found near Errol Island in 1906.

11. *Hippolyte zostericola* (Smith.).

Another small species, slightly resembling the last, which was also found near Errol Island in 1906.

12. *Concordia gibberosa* (Kingsley).

A small species, a few specimens of which were found among the sea weeds near Errol Island in the spring of 1906.

13. *Alpheus heterochelis* (Say).

The so-called "Pistol Crab," from its habit of making a sharp, cracking noise with its modified chela. Is common along the coast in sea weed and among the shells of the oyster reefs.

14. *Sergestes arcticus* (Kroyer).

A small shrimp-like form which is at times very abundant in Calcasien Pass. As yet only partly grown specimens have been taken. It has a general resemblance to the young individuals of *Penaeus setiferous*, but may be distinguished from them by the greater length of the antennae and the different shape of the body.

15. *Ogyris occidentalis* (Ortman).

A slender shrimp-like form which was found in the shallow water along the beach near Calcasien Pass. Only a few specimens have been found.

16. *Chloridella empusa* (Say). (Plate VI)

Although this is not a shrimp, but rather a distant relative of them, it is included in the present list, as it is often taken by the shrimp fishermen, who call it the "King Shrimp." The remarkable shape of the body is shown in the accompanying figure, which is of a small individual.

EXPLANATION OF PLATES.

Plate I. *Penaeus setiferous*. "Lake Shrimp." Side view.

Plate II. *Penaeus setiferous*. Dorsal view of a smaller individual.

Plate III. *Penaeus setiferous*. First and second pairs of swimmerets, of the male and female.

Plate IV. Figure 1—*Parapenaeus constrictus*.

Figure 2—*Xiphopenaeus kroyeri*.

Figure 3—*Sicyonia dorsalis*. Twice natural size.

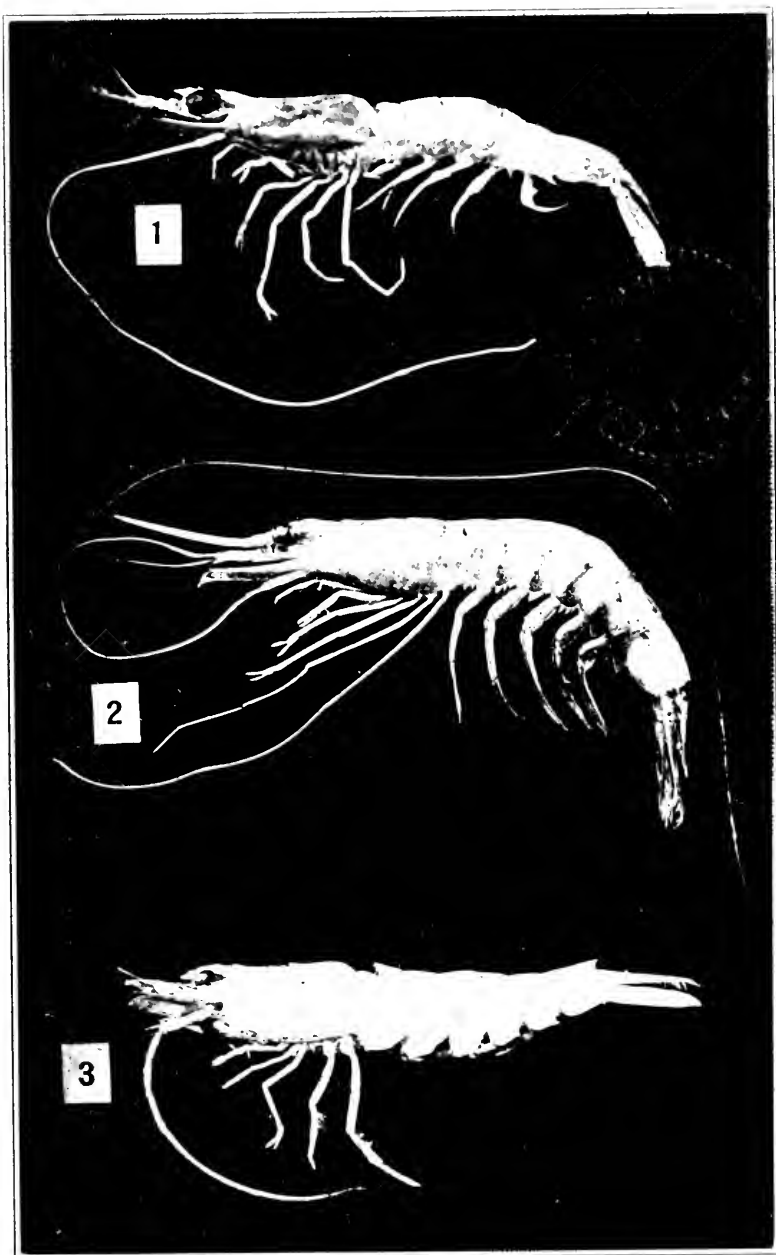
Plate V. Figure 1—*Bithynis ohionis*. Female with eggs.

Figure 2—*Palaemon tenuicornis*. Female with egg.
Twice natural size.

Figure 3—*Palaemonetes carolinus*. Female. Twice natural size.

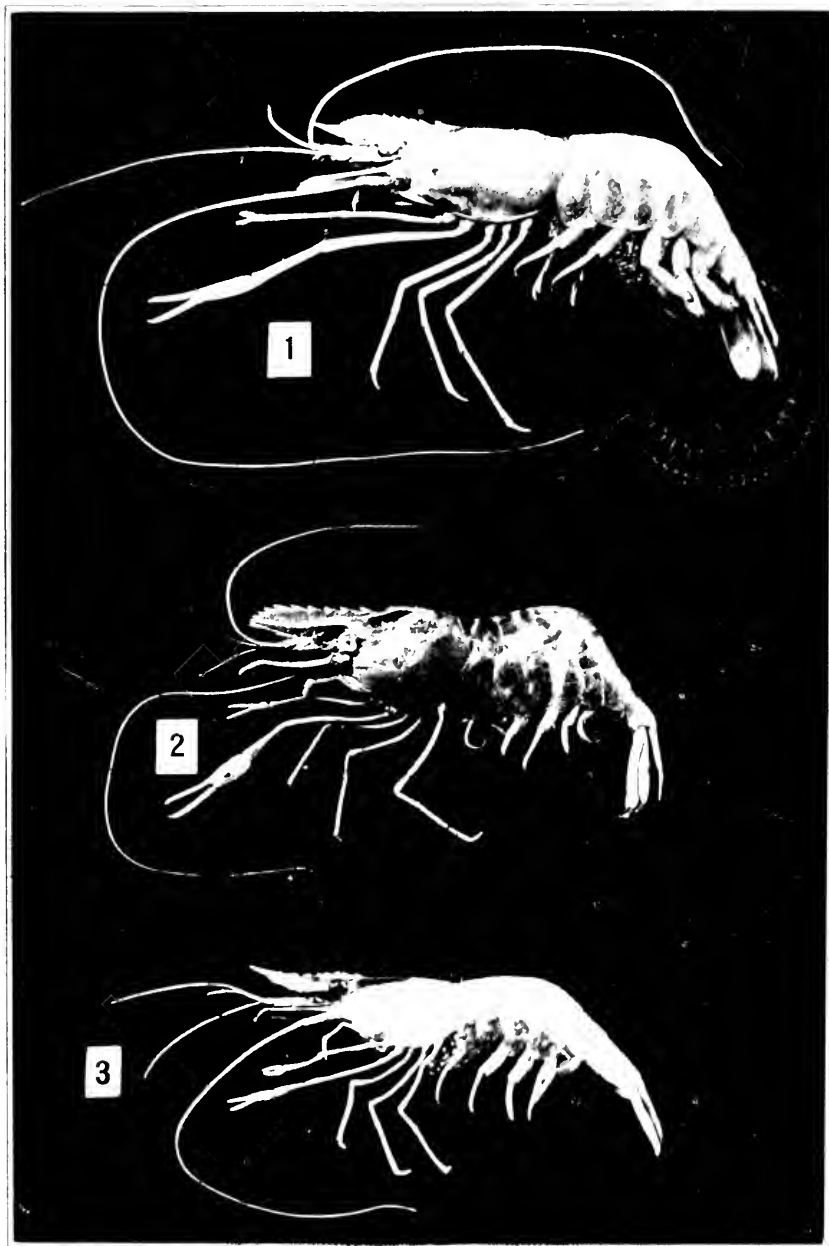
Plate VI. *Chloridella empusa*.

The figures of the entire animal are from photographs by the author and are natural size, unless otherwise stated.



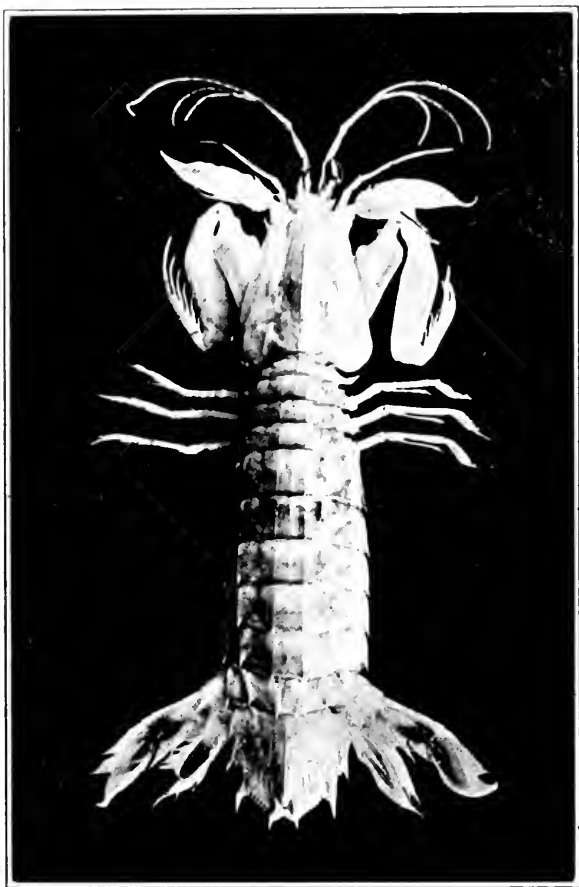
M. H. S., Photo.

PLATE IV.



M. H. S. Photo.

PLATE V.



M. H. S., Photo.

PLATE VI.



